PATENT SPECIFICATION

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Complete Accepted: Oct. 23, 1930.

COMPLETE SPECIFICATION.

Improvements in Pumps.

We, G. & J. WEIR, LIMITED, of Holm Foundry, Cathcart, Glasgow, a British Company, and CHARLES RUSSELL LANG, a Director of the said Company, of the same address, a British Subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The present invention relates to positive displacement pumps.

It is often desirable to alter the output of a pump without alteration of the speed at which it is driven. For example, in the case of a pump driven by an A.C. electric motor it may be desirable to have an arrangement whereby the pump output can be varied while the motor runs at constant speed.

The output can be altered without altering the speed—i.e. the number of cycles in a given time—by employing two or more plungers, pistons, or other positive displacers, and altering the relative movements of these displacers, their absolute movements remaining unchanged.

A pump according to the present invention comprises a body or holder containing fluid, an admission and a discharge valve—or other means for controlling the flow of the fluid into and out of the said body—and a pair of equal co-acting plungers, pistons, or other positive displacers (hereinafter referred to as displacers) driven each by a shaft, the shafts being connected together by gearing, the displacers acting within the said body to vary the net volumetric capacity or fluid content of the same.

The characteristic feature of the present invention resides in the fact that the two shafts are driven by the same means and in each case through double-reduction gearing involving an intermediate shaft carrying two gear wheels, and that the intermediate shaft appertaining to one of the first mentioned shafts is mounted in a swivelling carrier which is given a motion of partial rotation to alter the phase relationship of the two shafts.

Figs. 1 and 2 of the accompanying drawings illustrate the invention diagrammatically.

In Fig. 1 the two shafts are shown in phase, that is, with a phase difference or phase displacement of nil: in Fig. 2 they are shown with a phase difference of 180°.

a is the pump body or holder, *b* the admission valve, and *c* the discharge valve. *d*, *e* are the two displacers: they are driven respectively by the shafts *f*, *g* by means of the cranks *h*, *k*. *m* is a motor or power means (of any suitable nature) which drives the pump. It drives the shaft *n* which carries the gear wheel *r*. This gear wheel meshes with the gear wheel *s* on an intermediate shaft *t* which shaft also carries a gear wheel *u* which meshes with a gear wheel *w* on the shaft *g*. The gear wheel *r* also meshes with a gear wheel 2 which in turn meshes with a gear wheel 3 carried by an intermediate shaft 4 which also carries a gear wheel 5 which meshes with the gear wheel 6 on the shaft *f*.

The intermediate shaft *t* is carried by a frame or carrier *v* which is mounted to swivel about the axis of the shaft *n*. It is so swivelled by means of a worm *x* which drives a worm wheel *z*, carried by the carrier *v*. It will be obvious that, by swivelling the intermediate shaft *t* with its gear wheels, the phase relationship of the shafts *f* and *g* will be altered.

When the two shafts are in phase—as in Fig. 1—the co-operative displacement of the two displacers is a maximum. When the phase difference of the two shafts is 180°—as in Fig. 2—the co-operative displacement of the two displacers is approximately zero. (A slight variation from zero may be obtained due to obliquity of driving or connecting rods), and the output of the pump is nil, or practically so. With any phase difference between zero and 180° there is a corresponding pump output between nothing and the maximum.

The displacers were referred to above as being "equal co-acting". By this is meant that they have an equal displacement effect. It will in general be desirable to make them and work them exactly similarly; but precise similarity is not of course essential provided that their dis-

[*Price* 1/-]

placement effect is the same.

The throw or movement of each displacer will be obtained generally by a crank on its driving shaft, but it might be by an eccentric or other mechanical device generally equivalent to a crank.

The two shafts are shown in Figs. 1 and 2 in a "position of opposition" to each other. By a "position of opposition" is meant that the shafts are on opposite sides of the body or holder and such that they drive the displacers in coincident or parallel lines but in opposite directions. The two shafts might however if desired be arranged in any other way with respect to each other as may be convenient or desirable.

However the shafts are arranged, the expression "phase difference" is of course used in this specification to refer to the relative positions or conditions of the two shafts as regards their action on the displacers; that is, for example, the shafts would be considered to be in phase if the inmost positions which they gave to the displacers occurred at the same instant.

The rotation of the worm *x*—in order, by movement of the gear carrier *v*, to adjust the phase relationship of the two shafts—may be effected either by hand or automatically, and accomplished mechanically, electrically, or otherwise.

Figs. 3, 4, 5, and 6, illustrate a practical embodiment of the invention.

Fig. 3 is a plan of the arrangement.

Fig. 4 is an elevation partly in section.

Fig. 5 is a side elevation.

Fig. 6 is an elevation—partly diagrammatic—of the gear box.

The shafts *f*, *g* are driven by the electric motor 10 through gearing *r*, *s*, *u*, *w*, 2, 3, 5, 6, as described with reference to Figs. 1 and 2, this gearing being disposed in a gear box 8. Each shaft *f*, *g* has three cranks arranged at an angle of 120° to each other. Each crank, e.g. *h* drives a plunger, e.g. 23, 24. These plungers are disposed in pairs and co-operate thus. That is, each plunger driven by the one shaft co-operates with one driven by the other shaft. The plungers work in cylinders 15, 16; and each pair of cylinders 15, 16, with a top portion 17, constitutes a body according to the meaning in which this word has hereinbefore been used. Each body is provided with an inlet valve 18 and a discharge valve 19. The top portions of the bodies may be formed integrally as one casting, as shown in Fig. 5, but this is merely a matter of convenient construction.

The carrier *v* (as explained with reference to Figs. 1 and 2) is arranged to swivel about the axis of the shaft *r*. The swivelling action is performed by providing the carrier with a worm wheel 21 which is engaged by a worm 22 carried by a shaft 25 which carries a worm wheel 26 which is engaged by a worm 27 on a shaft 28 driven by a small electric motor 29.

A steam turbine may be employed to drive the pump. In this case the turbine may subsidiarily drive a small electric generator which will supply current to the small electric motor which effects the phase adjustment.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A pump comprising a body or holder containing fluid, an admission and a discharge valve—or other means for controlling the flow of the fluid into and out of the said body—and a pair of equal co-acting displacers driven each by a shaft, the shafts being connected together by gearing, the displacers acting within the said body to vary the net volumetric capacity or fluid content of the same, characterised thus, that the two shafts are driven by the same means and in each case through double-reduction gearing involving an intermediate shaft carrying two gear wheels, and that the intermediate shaft appertaining to one of the first mentioned shafts is mounted in a swivelling carrier which is given a motion of partial rotation to alter the phase relationship of the two shafts.

2. A pump as set forth in Claim 1 and in which the means employed for driving the shafts is a steam turbine, characterised by the fact that the gear wheel or gear wheels or carrier is moved to alter the phase relationship by a small electric motor which receives its current from an electric generator driven by the said turbine.

3. A pump as set forth in Claim 1 and with a gear wheel arrangement substantially as described and as illustrated in Figs. 3, 5, and 6.

4. A pump as set forth in Claim 1, further characterised by the employment of a plurality of pairs of equal co-acting displacers, each pair operating in a body provided with an inlet and a discharge valve, substantially as described.

5. A pump as set forth in Claim 6 with the further characterism that each shaft carries three cranks arranged at an angle of 120° to each other, that each crank drives a displacer, and that each displacer driven by the one shaft co-operates with one driven by the other shaft.

6. A pump as set forth in Claim 1, and

substantially as described with reference to Figs. 3, 4, 5, and 6 of the accompanying drawings.

Dated the 26th day of October, 1929.

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Chartered Patent Agent.

Redhill: Printed for His Majesty's Stationery Office, by Love & Malcomson, Ltd.—1936.

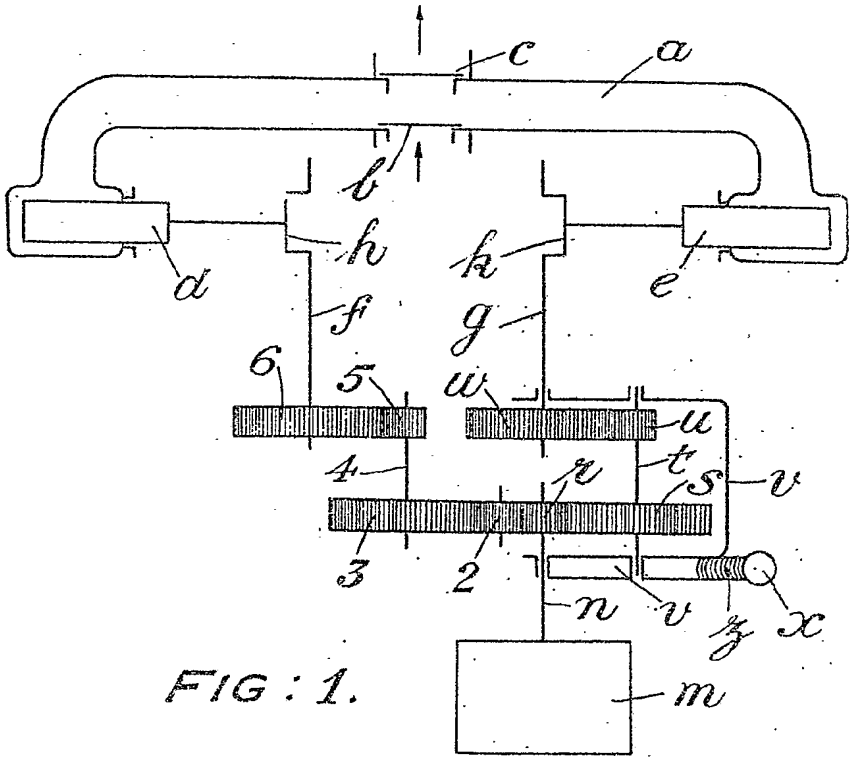

FIG: 1.

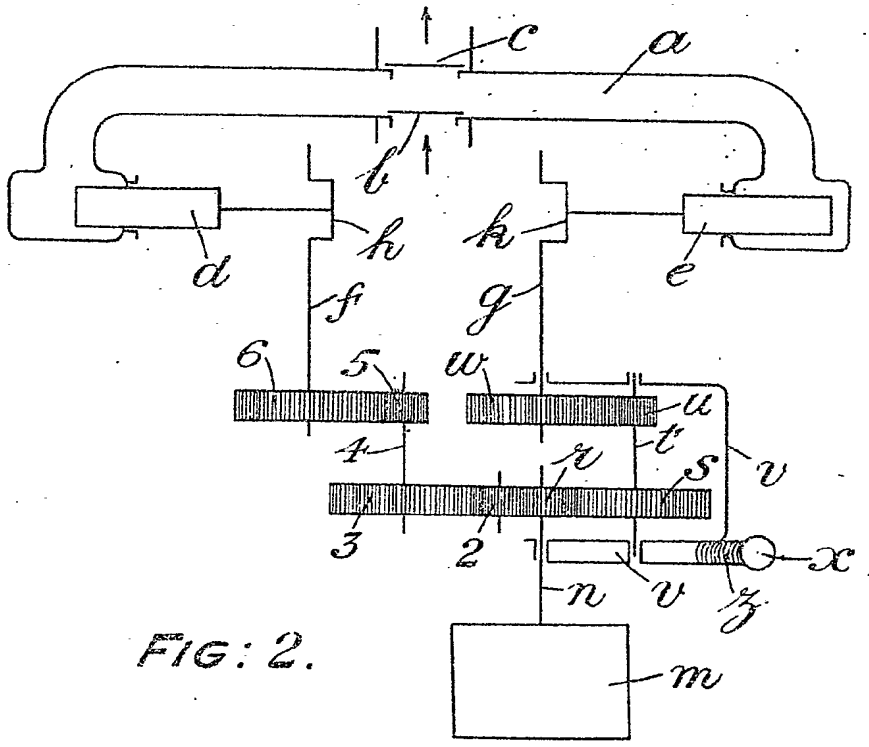

FIG: 2.

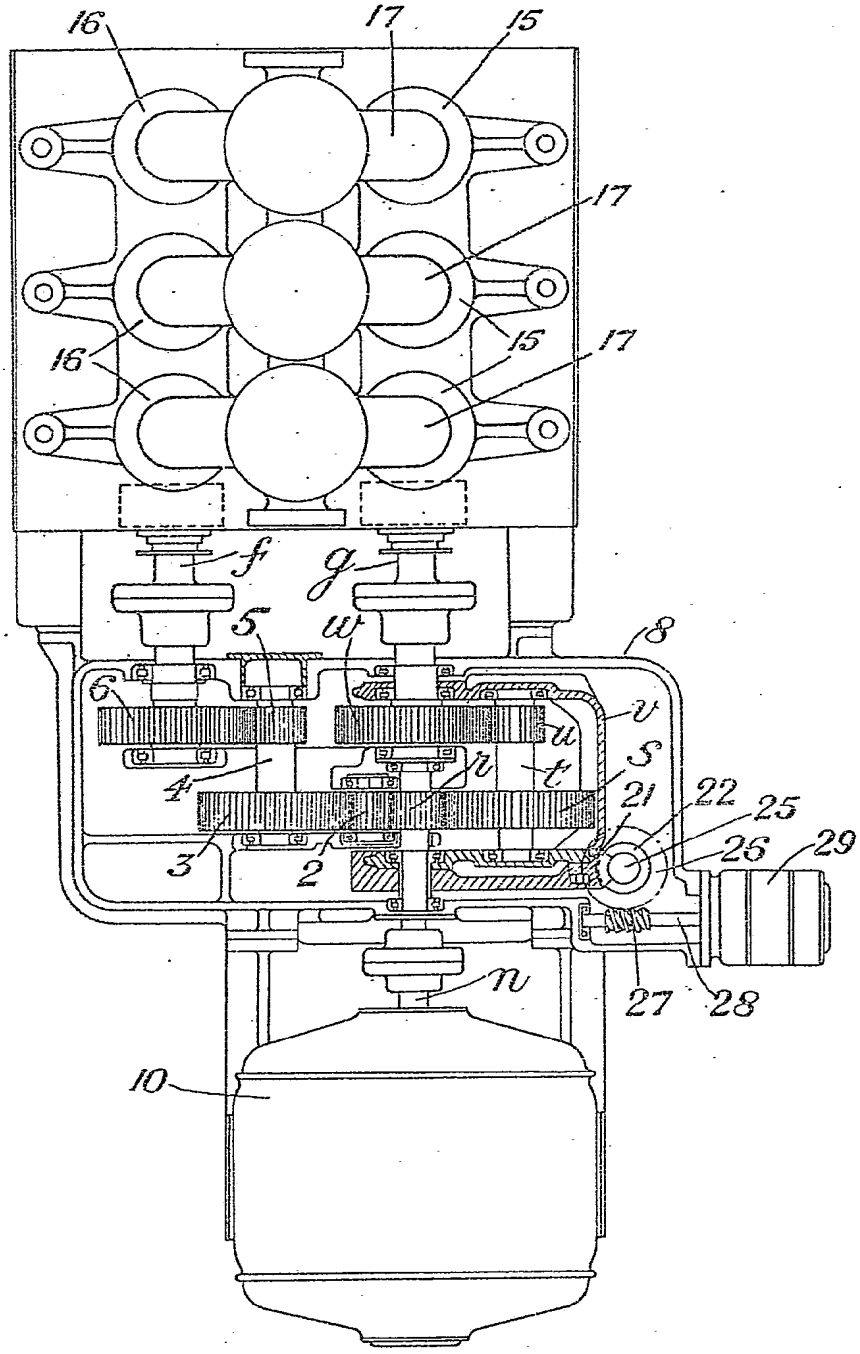

FIG : 3

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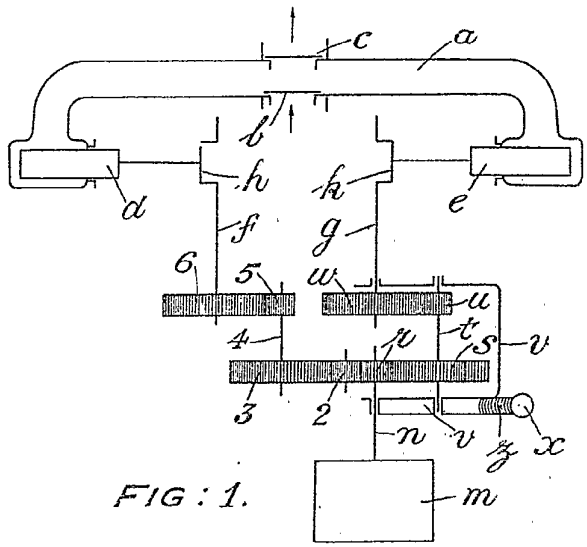

FIG: 1.

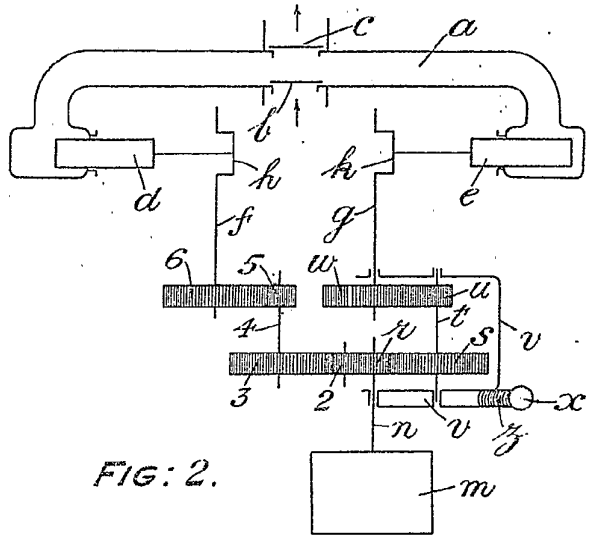

FIG: 2.

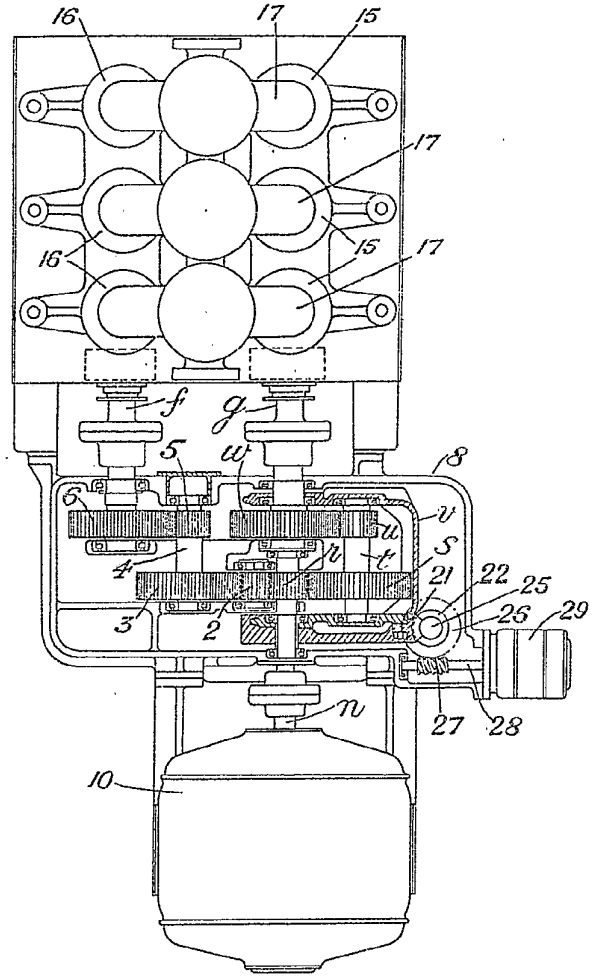

FIG: 3

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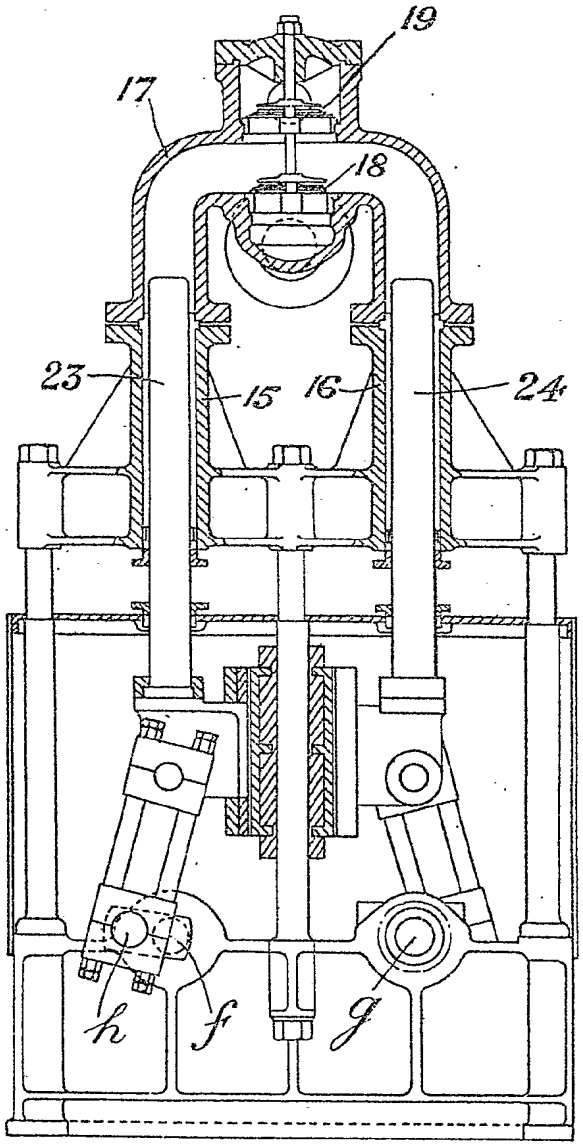

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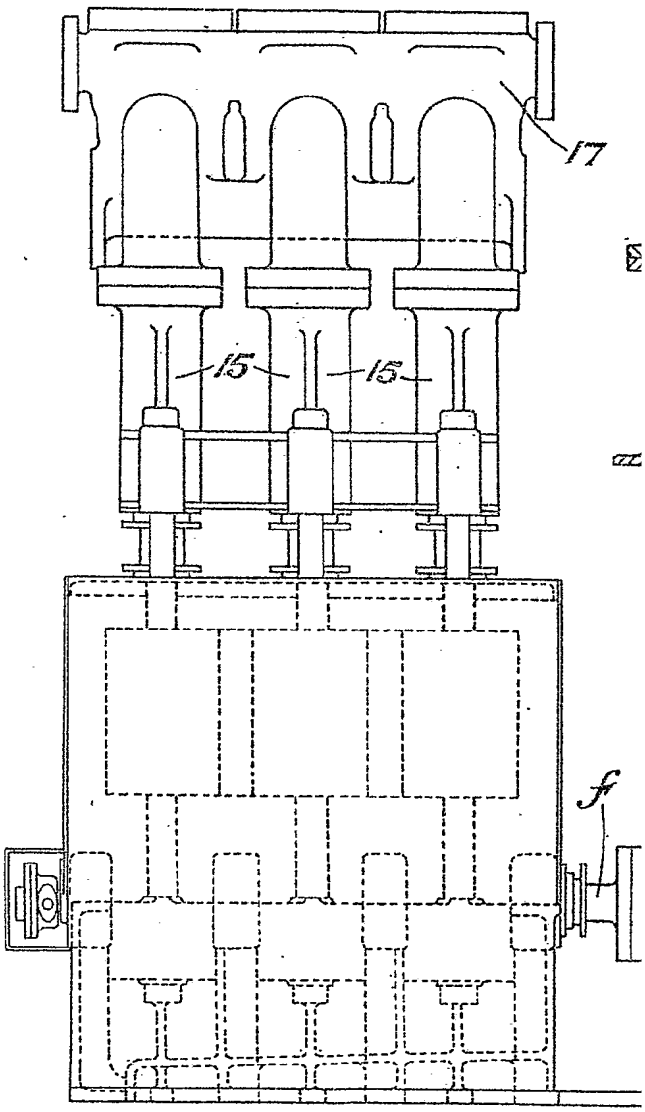
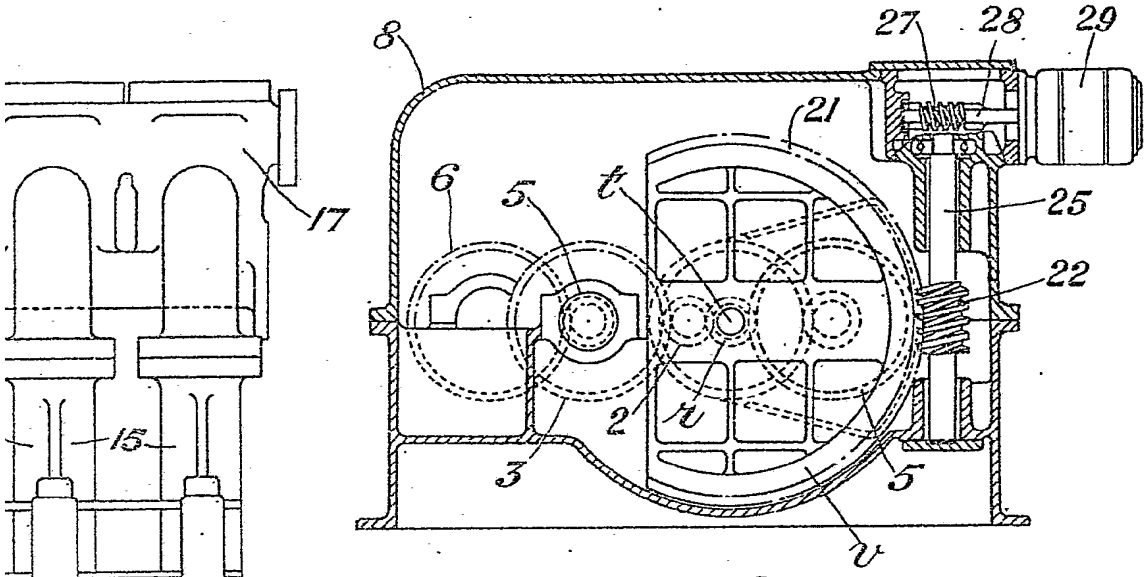


FIG: 4



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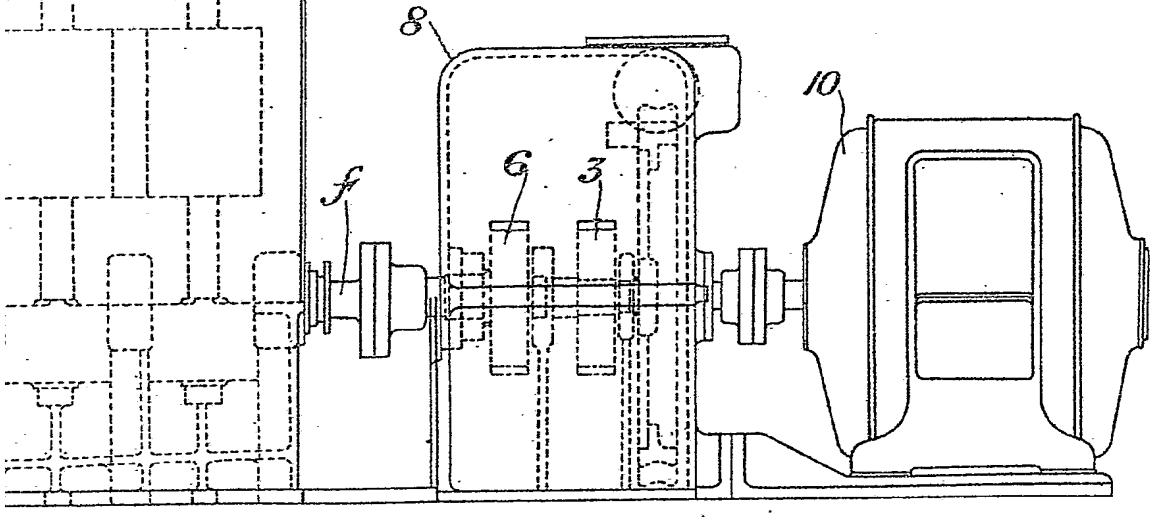

FIG: 5.

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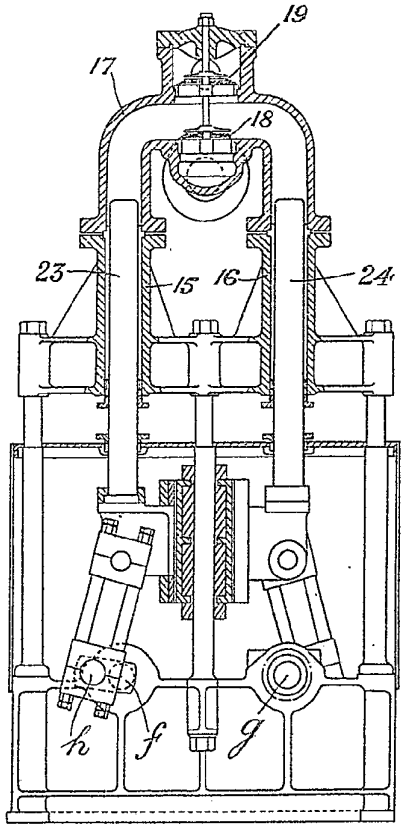
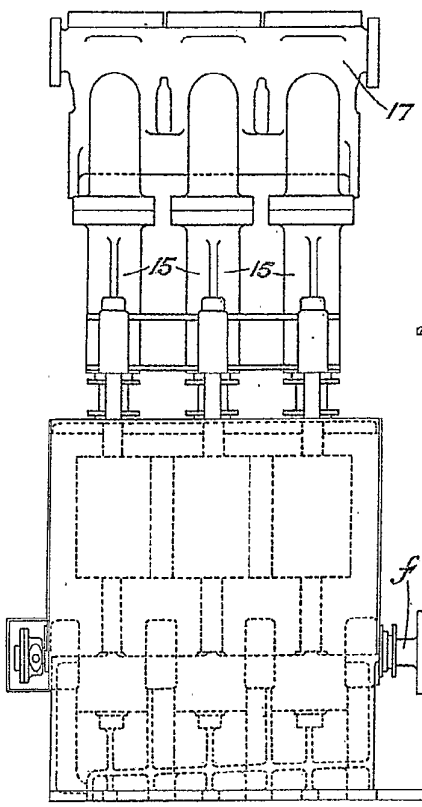


FIG: 4.



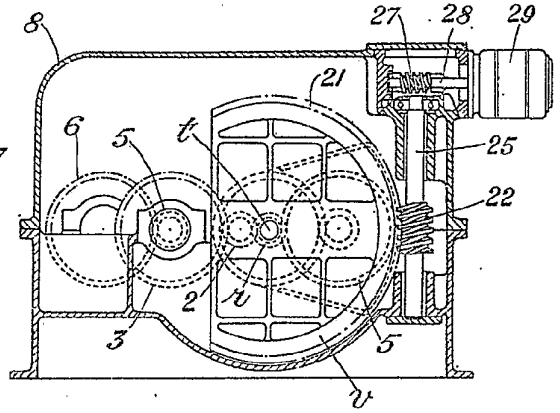


FIG: 6.

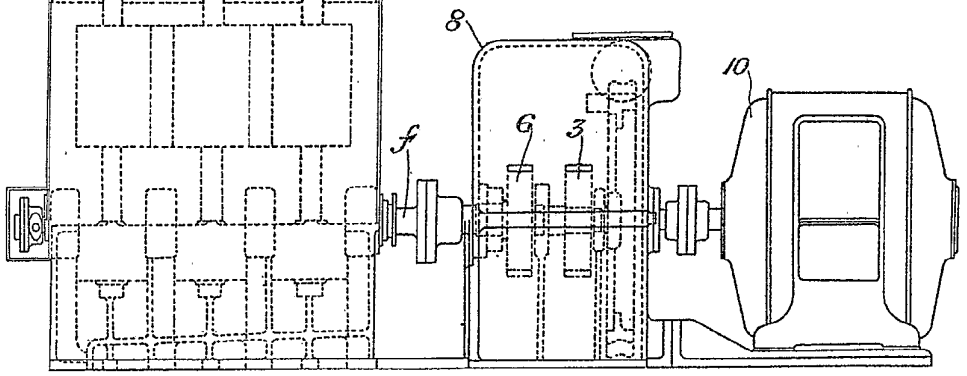


FIG: 5.

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